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Knee medial contact force response to Customised and Non-Customised foot orthotics: a musculoskeletal study in a Medial Knee Osteoarthritis population

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Introduction

Lateral wedged foot orthoses (LWFO) aim at re-establish a correct biomechanics in patients with medial knee osteoarthritis (MKOA). However, evidence supporting the effectiveness of LWFO is contrasting and may depend on the orthotics design [1]. Therefore, the purpose of this study was to estimate the effect of two different LWFO designs on the medial knee CF in participants with MKOA.

Methods

A 2x2 crossover trial was designed to compare the effect of two orthoses conditions on the knee medial contact force (MCF). The Lateral Wedge Technology Insole (SalfordInsole™, UK) was selected as a non-customized (NC) device while a 3D printing approach was developed to create a modular insole (MOD) customised to participants' foot geometry. Nineteen volunteers with MKOA (age 54.96 ± 5.78 years, BMI 30.9 ± 5.1 Kg·m⁻²) participated in this IRB approved study and provided informed consent.

Each participant attended 4 sessions: (1) First Shod Baseline, (2) First Orthotic, (3) Second Shod Baseline, (4) Second Orthotic. Marker-based three-dimensional kinematic data and ground reaction forces were recorded during each session. Participants were asked to use each of the two LWFO for a period of 12 days prior the test. A 1 week washout period was given between assessment (2) and (3). The LWFO order was randomly assigned.

An anatomically scaled musculoskeletal model was implemented using the Anybody Modeling System v.6.0.5 (AnyBody, Denmark)[2] to estimate the knee MCF.

The impulse of the MCF, corrected per bodyweight, was chosen to estimate the LWFO effect. Non-parametric Wilcoxon Signed Rank Tests were performed to determine the effect of the NC and MOD LWFO with respect to the shod baselines.

Results

The results indicated that the median of the impulse of the MCF for the NC, $Mdn=0.91$, was not significantly lower than the median at the corresponding baseline, $Mdn=0.95$, $Z=141$, $p<0.059$. The median of the impulse of the MCF for the MOD, $Mdn=0.96$, was significantly higher than the median at the corresponding baseline, $Mdn=0.93$, $Z=149$, $p<0.03$. No significant difference was found between the two baseline assessment, $Z=120$, $p<0.314$. No differences were found in the walking speed for both the NC and MOD with respect to the baselines.

Discussion

Our results showed a limited effect of the two LWFO on the MCF and a high variable response. The MCF increased significantly with the MOD while decreased not significantly with the NC. To improve significantly the effect of LWFO on the MCF, an innovative approach investigating further designs and different materials in the production of LWFO may merit further attention.

References

- [1] F. Xing et al. *Medicine (Baltimore)*, vol. 96, no. 24, p. e7168, 2017.
- [2] M.E. Lund et al. *Int. Biomech.*, vol. 2, no.1, pp. 1-11, 2015.

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